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ABSTRACT

A first, transmitting, device transmits a digitized data message using a short range radio link followed by digital data representing a digitized acoustic signal, such as a tone.

5 Simultaneously, or with a predetermined time delay, the transmitting device emits an acoustic version of the same signal using an acoustic transducer such as a loudspeaker. A second, receiving, device receives the data message and the digitized acoustic signal via the short range radio link and receives the
10 acoustic version of the signal via a microphone, which converts the acoustic signal to a second digitized version of the acoustic signal. Digital signal processing circuits then correlate the second digitized signal received acoustically with the digitized acoustic signal received over the short range radio link to
15 determine a time difference of arrival. The time difference is corrected for any predetermined delay between the radio and the acoustic signal emissions at the transmitter and predetermined processing delays in the receiver. Once the time delay is determined, the receiving device can determine its distance from
20 the transmitting device using the difference between the speed of sound and the speed of radio propagation.